AMENDMENTS TO THE CLAIMS

The listing of claims below replaces all prior versions of claims in the application.

1. (Currently Amended) A beam source comprising:

a plasma generating chamber;

a gas inlet port for introducing a gas into said plasma generating chamber;

a plasma generator for generating positive-negative ion plasma containing positive ions at a density of at least 10^{10} ions/cm^3 and negative ions from the gas;

a plasma potential adjustment electrode disposed in said plasma generating chamber;

a grid electrode having a plurality of beam extraction holes formed therein, said beam extraction holes having a size of at least 0.5 mm; ~~and~~

a first power supply for applying a voltage of at most 500 V between said plasma potential adjustment electrode and said grid electrode;

a coil disposed near said plasma generating chamber; and

a second power supply for intermittently supplying a high-frequency voltage to said coil.

2. (Cancelled)

3. (Currently Amended) A beam source comprising:

a plasma generating chamber;

a gas inlet port for introducing a gas into said plasma generating chamber;

a plasma generator for generating positive-negative ion plasma containing positive ions and negative ions from the gas;

a plurality of grid electrodes each having a plurality of beam extraction holes formed therein; ~~and~~

a first power supply for applying a voltage between said plurality of grid electrodes to accelerate the positive ions or the negative ions so as to pass through said beam extraction holes formed in said grid electrodes and to extract a neutralized beam from the positive ions or the negative ions or an ion beam;

a coil disposed near said plasma generating chamber; and

a second power supply for intermittently supplying a high-frequency voltage to said coil.

4. (Cancelled)

5. (Currently Amended) The beam source as recited in claim 3, further comprising a plasma potential adjustment electrode disposed in said plasma generating chamber[[,]]; and

~~wherein said first~~ a plasma potential adjustment power supply ~~applies~~ for applying a voltage between said plasma potential adjustment electrode and at least one of said grid electrodes.

6. (Currently Amended) The beam source as recited in claim 5, wherein said ~~first~~ plasma potential adjustment power supply applies a low voltage such that accelerated ions do not practically sputter said at least one of said grid electrodes.

7. (Currently Amended) The beam source as recited in claim 3, wherein said ~~pluralities~~ plurality of beam extraction holes in said plurality of grid electrodes are aligned with each other.

8. (Original) The beam source as recited in claim 3, wherein said plurality of beam extraction holes in at least one of said grid electrodes has an aspect ratio of at least 10.

9. (Currently Amended) A beam processing apparatus comprising:

a vacuum chamber;

a holder disposed in said vacuum chamber for holding a workpiece; and

a beam source for applying a beam to the workpiece held by said holder, said beam source comprising:

a plasma generating chamber;

a gas inlet port for introducing a gas into said plasma generating chamber;

a plasma generator for generating positive-negative ion plasma containing positive ions at a density of at least 10^{10} ions/cm^3 and negative ions from the gas;

a plasma potential adjustment electrode disposed in said plasma generating chamber;

a grid electrode having a plurality of beam extraction holes formed therein, said beam extraction holes having a size of at least 0.5 mm; ~~and~~

a first power supply for applying a voltage of at most 500 V between said plasma potential adjustment electrode and said grid electrode;

a coil disposed near said plasma generating chamber; and

a second power supply for intermittently supplying a high-frequency voltage to said coil.

10. (Cancelled).

11. (Currently Amended) A beam processing apparatus comprising:

a vacuum chamber;

a holder disposed in said vacuum chamber for holding a workpiece; and

a beam source for applying a beam to the workpiece held by said holder, said beam source comprising:

a plasma generating chamber;

a gas inlet port for introducing a gas into said plasma generating chamber;

a plasma generator for generating positive-negative ion plasma containing positive ions and negative ions from the gas;

a plurality of grid electrodes each having a plurality of beam extraction holes formed therein; ~~and~~

a first power supply for applying a voltage between said plurality of grid electrodes to accelerate the positive ions or the negative ions so as to pass through said beam extraction holes formed in said grid electrodes and to extract a neutralized beam from the positive ions or the negative ions or an ion beam;

a coil disposed near said plasma generating chamber; and

a second power supply for intermittently supplying a high-frequency voltage to said coil.

12. (Cancelled)

13. (Currently Amended) The beam processing apparatus as recited in claim 11, further comprising a plasma potential adjustment electrode disposed in said plasma generating chamber[[,]] ; and

~~wherein said first~~ a plasma potential adjustment power supply ~~applies~~ for applying a voltage between said plasma potential adjustment electrode and at least one of said grid electrodes.

14. (Currently Amended) The beam processing apparatus as recited in claim 13, wherein said ~~first~~ plasma potential adjustment power supply applies a low voltage such that accelerated ions do not practically sputter said at least one of said grid electrodes.

15. (Currently Amended) The beam processing apparatus as recited in claim 11, wherein said ~~pluralities~~ plurality of beam extraction holes in said plurality of grid electrodes are aligned with each other.

16. (Original) The beam processing apparatus as recited in claim 11, wherein said plurality of beam extraction holes in at least one of said grid electrodes has an aspect ratio of at least 10.

17. (New) The beam source as recited in claim 1, wherein said second power supply is configured to interrupt application of the high-frequency voltage for a period of time that is sufficiently longer than a period of time in which electrodes in the positive-negative ion plasma are attached to the gas to generate the negative ions and sufficiently shorter than a period of time

in which an electron density in the positive-negative ion plasma is lowered to extinguish the positive-negative ion plasma and to apply the high-frequency voltage for a period of time that is long enough to recover an energy of the electrons in the positive-negative ion plasma which has been lowered during the interruption of the high-frequency voltage.

18. (New) The beam source as recited in claim 3, wherein said second power supply is configured to interrupt application of the high-frequency voltage for a period of time that is sufficiently longer than a period of time in which electrons in the positive-negative ion plasma are attached to the gas to generate the negative ions and sufficiently shorter than a period of time in which an electron density in the positive-negative ion plasma is lowered to extinguish the positive-negative ion plasma and to apply the high-frequency voltage for a period of time that is long enough to recover an energy of the electrons in the positive-negative ion plasma which has been lowered during the interruption of the high-frequency voltage.

19. (New) The beam processing apparatus as recited in claim 9, wherein said second power supply is configured to interrupt application of the high-frequency voltage for a period of time that is sufficiently longer than a period of time in which electrons in the positive-negative ion plasma are attached to the gas to generate the negative ions and sufficiently shorter than a period of time in which an electron density in the positive-negative ion plasma is lowered to extinguish the positive-negative ion plasma and to apply the high-frequency voltage for a period of time that is long enough to recover an energy of the electrons in the positive-negative ion plasma which has been lowered during the interruption of the high-frequency voltage.

20. (New) The beam processing apparatus as recited in claim 11, wherein said second power supply is configured to interrupt application of the high-frequency voltage for a period of time that is sufficiently longer than a period of time in which electrons in the positive-negative ion plasma are attached to the gas to generate the negative ions and sufficiently short than a period of time in which an electron density in the positive-negative ion plasma is lowered to extinguish the positive-negative ion plasma and to apply the high-frequency voltage for a period of time that is long enough to recover an energy of the electrons in the positive-negative ion plasma which has been lowered during the interruption of the high-frequency voltage.

21. (New) A beam source comprising:

a plasma generating chamber;

a gas inlet port for introducing a gas into said plasma generating chamber;

a plasma generator for generating positive-negative ion plasma containing positive ions and negative ions from the gas;

a plurality of grid electrodes each having a plurality of beam extraction holes formed therein;

a first power supply for applying a voltage between said plurality of grid electrodes to accelerate the positive ions or the negative ions so as to pass through said beam extraction holes formed in said grid electrodes and to extract a neutralized beam from the positive ions or the negative ions or an ion beam;

a plasma potential adjustment electrode disposed in said plasma generating chamber; and

a plasma potential adjustment power supply for applying a voltage between said plasma potential adjustment electrode and at least one of said grid electrodes.

22. (New) The beam source as recited in claim 21, wherein said plasma potential adjustment power supply applies a low voltage such that accelerated ions do not practically sputter said at least one of said grid electrodes.

23. (New) The beam source as recited in claim 21, further comprising:

a coil disposed near said plasma generating chamber; and

a second power supply for intermittently supplying a high-frequency voltage to said coil.

24. (New) The beam source as recited in claim 23, wherein said second power supply is configured to interrupt application of the high-frequency voltage for a period of time that is sufficiently longer than a period of time in which electrons in the positive-negative ion plasma are attached to the gas to generate the negative ions and sufficiently shorter than a period of time in which an electron density in the positive-negative ion plasma is lowered to extinguish the positive-negative ion plasma and to apply the high-frequency voltage for a period of time that is long enough to recover an energy of the electrons in the positive-negative ion plasma which has been lowered during the interruption of the high-frequency voltage.

25. (New) A beam processing apparatus comprising:

a vacuum chamber;

a holder disposed in said vacuum chamber for holding a workpiece; and

a beam source for applying a beam to the workpiece held by said holder, said beam source comprising:

a plasma generating chamber;

a gas inlet port for introducing a gas into said plasma generating chamber;

a plasma generator for generating positive-negative ion plasma containing positive ions and negative ions from the gas;

a plurality of grid electrodes each having a plurality of beam extraction holes formed therein;

a first power supply for applying a voltage between said plurality of grid electrodes to accelerate the positive ions or the negative ions so as to pass through said beam extraction holes formed in said grid electrodes and to extract a neutralized beam from the positive ions or the negative ions or an ion beam;

a plasma potential adjustment electrode disposed in said plasma generating chamber; and

a plasma potential adjustment power supply for applying a voltage between said plasma potential adjustment electrode and at least one of said grid electrodes.

26. (New) The beam processing apparatus as recited in claim 25, wherein said plasma potential adjustment power supply applies a low voltage such that accelerated ions do not practically sputter said at least one of said grid electrodes.

27. (New) The beam processing apparatus as recited in claim 25, further comprising:

a coil disposed near said plasma generating chamber; and

a second power supply for intermittently supplying a high-frequency voltage to said coil.

28. (New) The beam processing apparatus as recited in claim 27, wherein said second power supply is configured to interrupt application of the high-frequency voltage for a period of time that is sufficiently longer than a period of time in which electrons in the positive-negative ion plasma are attached to the gas to generate the negative ions and sufficiently shorter than a period of time in which an electron density in the positive-negative ion plasma is lowered to extinguish the positive-negative ion plasma and to apply the high-frequency voltage for a period of time that is long enough to recover an energy of the electrons in the positive-negative ion plasma which has been lowered during the interruption of the high-frequency voltage.